NEW COMPLIANT PRESS-FIT BOARD PRODUCTS

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The need to lower manufacturing costs has never been more evident than in today's industry. This paper discusses a new product technology that is gaining considerable recognition as its benefits are realized for the pcb manufacturer and end user. This technology is compliant press-fit interconnection technology. Realizing that the design goals and application considerations are primary concerns in evaluating a connector's performance, I will be reviewing these areas on one compliant press-fit product line.

A compliant press-fit connection is a solderless interference-fit between a terminal and a plated-through hole (P.T.H.) in a printed circuit board (P.C.B.). Good mechanical retention and good electrical characteristics are achieved by generating high radial forces from the terminal's press-fit section to the walls of the P.T.H. Compliant means that the press-fit section will comply to the smaller hole size, yet keep hole distortion to a minimum. Two product variations within this compliant press-fit interconnection technology are the press-fit pin which mates to standard 0.025" female receptacles and the press-fit edge card connector for mother-daughter board applications.

This new technology is quickly gaining wide usage over solder connections and non-compliant press-fit connections. Since all three connections are considered reliable, the primary reason for using compliant press-fit products is cost savings and manufacturing flexibility. For many years the solder joint has been a very reliable connection system. It requires a precision P.T.H., having a tolerance of ± 0.002" and the terminals must be soldered after assembly. Because of the precision hole and the necessary soldering operation, applied costs are high.

The non-compliant press-fit joint has been widely accepted because it does not require soldering and repairs can easily be made, resulting in a cost savings over the solder joint. It also requires a precision P.T.H., having a tolerance of ± 0.002". Because of this, most systems available today require the user to purchase entire backpanel assemblies from the terminal manufacturer. This is an expensive method for users who have already invested in P.C.B. manufacturing facilities.

The Berg compliant press-fit section does not require the use of solder, and because it is compliant, can function reliably in a large tolerance hole of ± 0.004". As a result, the non-compliant press-fit connector allows the user to manufacture his own P.C.B.'s with less stringent plating controls providing him with design and manufacturing flexibility.

The design goals to produce a reliable press-fit edge card connector meant that various customer applications and requirements be considered as well as manufacturing and assembly capabilities.

Primary design goals were to produce a connector with a compliant printed circuit board press-fit section, an edge

card spring contact, and a wire-wrap or I/O pin that could be machine or manually inserted into the pc board to meet various application requirements.

After considerable review it was determined the compliant press-fit section should:

a) function reliably in a wide tolerance plated-through hole (0.039" ± 0.004") of fiberglass FRA or equivalent laminate 0.093" to 0.187" thick.

This section of the design was of primary importance; a press-fit hole interface affords application cost savings to the customer compared to the conventional solder joint connection. In addition, the tolerance of 0.004" permits more boards to be accepted to tolerance specification, thus increasing productivity and minimizing board manufacturing cost.

This press-fit section should also:

b) provide 8 lbs. minimum push-out force.

Since this push-out force has become an industry standard as a wire-wrap specification on an 0.025" square pin with 26 AWG wire assuring good electrical and mechanical connections.

This press-fit section should:

c) not damage the plated-through hole (not fracture the copper plating or break any inner layers on a multilayer board).

This is also an industry requirement. Any copper fracture could result in a shorting condition; overstressing the fiberglass could result in excessive hole relaxation and below normal thermal shock results.

The press-fit section should have the capability to:

d) be removed and replaced 3 times and still maintain the 8 lbs. push-out force without damaging the board or the hole.

This goal is also an industry standard assuring integrity of the pin.

The last design goal of the press-fit section was that this section should:

e) form a gas-tight connection with a plated-through hole by making contact with the copper plating moving the solder plating aside.

This goal was considered of primary importance to provide a reliable interconnection.

The edge card spring contact of this connector was also of primary importance in the design goals. It was determined that the edge card spring contact should:

a) provide 3.5 ozs. (100 gms) minimum normal force per contact with 2 oz/contact pair minimum withdrawal force,

to provide good electrical contact on the gold plated finger pads.

This edge card spring contact should also:

b) provide 16 ozs. (450 gms) maximum normal force per contact with 12 ozs/contact pair minimum insertion force.

This 450 gms. is the highest force allowable to prevent any gold plating damage from subsequent insertion and withdrawal of the daughter board.

This edge card spring contact should have dimensions that would allow a functional spring and yet use a minimum amount of backplane real estate.

Selecting the wire-wrap I/O pin design goals was an easy task of duplicating Berg standard pin specifications, i.e.,

a) allow for an 0.100" X 0.100" minimum and an 0.250" X 0.250" maximum center spacing,
b) have a pin length of 0.170" minimum to 0.800" maximum,
c) have a pin tip that is within 0.015" diameter of true position regardless of pin length.

The application equipment goals were to provide various types of application equipment all based on the premise that the terminals would be press-fit into the backplane PCB and then the housing mounted over the contact.

The new Berg press-fit edge card connector meets the established requirement design goals.

The product consists of terminals and housings - the terminals have an 0.250" square wire-wrapping pin with a compliant press-fit section and an edge card spring contact. The housing is assembled over the terminals after they are staked into the PCB. It supports and protects the terminals; it guides and supports the daughter board.

The press-fit section of the connector is referred to as the "Bow-tie" because of its shape. The exterior surfaces of the section are rounded. This provides a smooth blend between the bow-tie section and the plated surface of the hole. It also prevents any cutting action that occurs if the corners of the section are sharp.

The conical entry from the pin section to the press-fit is swage hardened when formed. Hence, this area is very strong and can withstand torsional loads greater than the 0.025" square pin.

The narrowed center area allows the press-fit section to comply to the hole size. As set forth in the design goals, it provides a reliable mechanical and electrical connection with a plated-through hole with a tolerance of ± 0.004".

In large holes, the press-fit section applies high radial forces to the plated-through hole to maintain a terminal to the board push-out force of no less than 8 lbs. In the larger (up to 0.043" dia.) holes, the press-fit section complies to the size of the hole without the radial forces increasing to a point where hole damage occurs to either the plating or the laminate. In the smaller (down to 0.035") diameter holes, the push-out force increases to approximately 21 lbs.

This bow-tie section will comply to the hole in this manner. In the large hole the narrowed section compresses, providing high radial forces to the hole. In the smaller 0.035" dia. hole, the narrowed section moves to tolerate the hole size. Because of these moderate forces, the damage to plating on the laminate of the PTH is less likely to occur. To further insure against plating damage, a rounded interface with the PTH is provided. This prevents any cutting action in the PTH.

The edge card spring contact is supported at both ends by the plastic housing. At point B, the housing holds the spring contact and prevents any spring deflection from being transmitted to the press-fit section. At point A, the spring contact is free to pivot. This pivoting motion decreases the pressure between the edge card contact and the daughter board when inserted. Although low, when the daughter board is inserted, high normal forces are present.

The edge card spring contact meets the defined goals as established. The contact has a selective strip of 30μ" Au over 50μ" Ni in the contact area. It meets the minimum and maximum normal force specifications for 100 gms and 450 gms respectively.

The wire-wrap I/O pin has a minimum center-to-center line spacing of 0.100", a maximum center-to-center line spacing of 0.250". The length varies from 0.170" to 0.800" and the tip of the pin is 0.015" diameter of true position.

One of the mst important aspects of a connector is its total applied cost. Each type of application machine must provide the best economical results for specific volume requirements.

The first type of machine developed is a computer controlled XYZ machine. The X and Y coordinates position the pcb for staking. This quantity is from 1-5 per cycle and is computer program controlled. The pcb locating table has a dial plate that rotates 360° to allow for staking 1/2 the total number of terminals, rotating the table and staking the opposite row of terminals. The product does not require opposing terminals to achieve proper normal force. As a result, if a pcb circuit does not require all terminal locations, this machine can be programmed to skip locations, thus allowing for significant cost savings.

This machine runs at a speed of 90 cycles per minute. At 5 terminals per cycle, a staking rate of 27,000 terminals per hour can be achieved. It is recommended for volume applications of 20 million lines per year.

For volumes of less than 20 million lines per year, a pantograph machine with an X-Y table to hold the pcb is recommended. This machine is manually operated by probing a template which triggers a mechanism that signals the terminal to be staked when the pcb is in the proper position. Although the staking rate is dependent on operator dexterity, the average staking rate is 3,500 terminals per hour.

Compliant press-fit technology is a cost effective and electrically reliable alternative to soldering connections. The Berg Electronics connector meets established design goals and manufacturers' requirements for good performance and low assembly costs.